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Issued April 16, 1908.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY.—CIRCULAR 129.

A. D. MELVIN, CHIEF OF BUREAU.

RABIES AND ITS INCREASING PREVALENCE.

BY

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., January 30, 1908.

SIR: I have the honor to transmit herewith, and to recommend for publication in the circular series of this Bureau, a manuscript entitled "Rabies and Its Increasing Prevalence," by George H. Hart, of the Pathological Division.

Rabies, or hydrophobia, is known to be one of the most terrible diseases that afflict humanity. Wherever it is prevalent it causes constantly increasing anxiety, suffering, and death to man and beast, not to mention the financial loss, and these penalties are exacted notwithstanding the alleviation offered by the Pasteur treatment. The enormous value of this treatment as a preventive agent is unquestioned, and while its effectiveness is extremely high when taken in time, the actual figures from a number of Pasteur institutes in different parts of the world show that the failures have ranged from 0.18 to 1.58 per cent. It must be remembered also that for a number of reasons, not the least of which are the inconvenience and expense connected with it, a large proportion of the persons, and almost all the animals, that have received the virus through bites do not undergo the treatment. Thus so long as the present conditions exist this dreadful menace will continue among us.

Unfortunately, too, we have indubitable evidence that the disease is increasing in the United States, and although, as the author points out, rabies is theoretically one of the most easily eradicated of all contagious diseases, there are, nevertheless, well-nigh insurmountable difficulties to be contended with. All that is required to rid us of this scourge is the muzzling of all dogs for a few years. This has been amply proved by the experience of several European countries where the disease has been stamped out in this manner.

But the carrying out of such a measure in this country is not easy. The Federal Government can not act alone in the matter; it is necessary to secure the cooperation of the States and of the people at large. It seems, therefore, desirable that the information contained in the accompanying paper be given the widest publicity.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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RABIES AND ITS INCREASING PREVALENCE.

HISTORY AND PREVALENCE OF RABIES IN THE DISTRICT OF COLUMBIA.

Although rabies has probably existed in this section of the country for an indefinite period of time, the attention of the medical and veterinary professions was not called to it until 1892, when a resident of the District died of the disease and the diagnosis was confirmed by rabbit inoculations at the Bureau of Animal Industry. Following this case the Bureau, in conjunction with the local veterinarians, made a more careful examination of the dogs in the District, with the result that 11 cases were found during 1893. In 1895 a second human death occurred, and as a result of this the Pathological Division of the Bureau, in cooperation with the District health office, started a routine examination of all cases of suspected rabies in and about the District of Columbia. This work has been continued up to the present time, and the following number of cases have been diagnosed:

1895, 4 dogs, 2 foxes.

1896, 5 dogs.

1897, 2 dogs, 1 cow.

1898, 7 dogs.

1899, January to June, 4 cases.

For the fiscal year ending June 30—

1900, 45 dogs, 4 cows, 1 cat, 1 horse.

1901, 15 dogs, 1 cat.

1902, 19 dogs, 3 cows, 1 horse, 1 hog, 1 woman.

1903, 28 dogs, 5 cows, 3 wolves, 1 fox, 1 horse.

1904, 19 dogs, 2 cows, 1 hog.

1905, 20 dogs, 1 cow, 1 cat.

1906, 15 dogs, 1 cow.

1907, 25 dogs, 1 sheep, 1 cat.

For the six months ending December 31, 1907, 19 dogs, 1 cow, 4 dingoes.

For the calendar year ending December 31, 1907, 37 dogs, 1 cow, 4 dingoes, 1 sheep, 1 cat.

While some of the above recorded cases have been forwarded to this laboratory from far distant parts of the country, at least 75 per cent of them have been from Washington and its immediate vicinity.

The figures show at a glance that during the last dozen years rabies has by no means been a rare disease in our capital city. And these statistics do not begin to cover all cases, as it is reasonably certain that a number of animals have been killed or have died without the disease being recognized. Furthermore, unless some persons or animals have been bitten, the carcasses are seldom forwarded to the laboratory, even though such cases were recognized as rabies by competent veterinarians. Only in atypical cases are carcasses examined for practicing veterinarians to confirm their diagnosis.

The alarming increase of the disease in the latter part of 1899 led to a proclamation by the District Commissioners providing for the muzzling of all dogs for a period of six months, from December 19, 1899, to June 18, 1900. This met with such determined opposition on the part of dog owners that it was never properly enforced by the police; and muzzling has therefore never received a fair trial in the District. At that time, however, the pound service was increased, and 3,598 dogs were impounded during the year, an increase of no less than 2,771 over the previous year. The income from the dog tax also increased from \$210.14 to \$2,030.83. The impounding and taxing were important; and, as the muzzling was not generally adopted, to them alone can be ascribed the decrease in the disease during the following year.

The last human death from rabies in the District was that of a colored woman in 1902, a pathological report of which can be found in the Twentieth Annual Report of the Bureau of Animal Industry (1903).^a In 1906, of the 16 cases received only 6 came from within the District; and it was thought that the careful quarantining or destruction of all animals bitten by rabid dogs, which had been conducted by the health department, was proving efficient in checking the advance of the disease. However, from January 1 to December 31, 1907, 44 positive cases have been examined in this laboratory. Of this number 33 were from the District or the immediately surrounding country. These 33 animals have, to our knowledge, bitten 16 persons, 46 dogs, 2 horses, and 2 cows. It therefore seems that the preventive measures at present being taken are entirely inadequate to cope with the disease, and its frequency during the last ten months has been alarming. The same condition of affairs unfortunately exists in many other cities of our country.

^a The report of this case is reprinted as Bureau of Animal Industry Circular 54.

NATIONAL PREVALENCE OF THE DISEASE.

From the foregoing facts it may well be inferred that rabies is one of the most important infectious diseases among domestic animals in the District. Since 1903 positive cases have also been forwarded to this laboratory for examination from Virginia, Maryland, Indian Territory, Indiana, North Carolina, South Carolina, West Virginia, Georgia, New Jersey, Maine, and Wisconsin.

In the State of Pennsylvania rabies has existed for years, and in 1905 Dr. C. J. Marshall reported in the "Proceedings of the American Veterinary Medical Association" that it was spreading more than in former years. In 1906 hardly a county was free from the disease, and, besides the cases in dogs, 47 cattle, 14 hogs, and 157 sheep died of the disease. An epidemic occurred in Chester County, Pa., in the past summer (1907) which necessitated the destruction of 154 dogs, 25 cows, and 10 horses.

During 1906 a severe outbreak occurred in Waterbury, Conn., 175 dogs being destroyed, and several persons bitten by rabid animals were obliged to take the Pasteur treatment. At Torrington, Conn., 7 dairy cows on one farm died of the disease. It also appeared in several other counties of the State.

In the autumn of 1905 and spring of 1906 a very severe outbreak of the disease occurred in Jacksonville, Fla., and was reported by Dr. J. G. Hill; 1,200 dogs were destroyed, and of 12 persons bitten by rabid animals 3 died of hydrophobia. The disease became so alarming that on August 1, 1906, a muzzling law was put into effect, which was very successful in stopping its ravages.

In Indiana Dr. J. H. Roberts reported that rabies was prevalent in the State and gave the State veterinarian more trouble than any other one infectious disease. The State secretaries of the American Veterinary Medical Association from Mississippi, New York, and New Jersey reported the existence of the disease in their respective States during 1906. The Chicago Pasteur Institute since its foundation in 1890 has applied the preventive treatment to persons bitten by rabid animals from nearly every State west of the Mississippi River.

In Norfolk, Va., the disease has prevailed extensively during the past five years and many human beings have been bitten, one large hound having severely bitten 9 persons before he was finally destroyed. In Charleston, W. Va., the disease is very common at present, one veterinarian writing to this laboratory that 12 cows and 40 dogs affected with the disease had recently come under his observation.

The State live stock sanitary board of Minnesota, at St. Paul, is now making routine examinations for rabies, and a considerable number of cases are being found.

It will thus be seen that rabies is all too prevalent throughout our country. It is constantly spreading and causing increased financial loss, human suffering, and death year by year. There is abundant evidence to warrant the statement that not a single State is free from the disease.

IMPORTANCE OF THE DISEASE.

From an economic standpoint the losses from rabies are difficult to ascertain. While a great many cases have been included in the foregoing reports, it is well known that many isolated cases of the disease are never covered by health reports. The actual money loss, while considerable, is not nearly as great as that from many of the major infectious diseases of animals.

It is not from its financial side, however, that rabies deserves so much attention from sanitarians. There is no disease in the entire realm of medicine the suffering from which is any greater than from hydrophobia. The dread with which the people speak of the malady and the awful agony suffered by those who undergo the course of the disease render it of such importance that health authorities should use every means at their disposal to secure its eradication. The great anxiety occasioned yearly in several thousand persons who are bitten by rabid or supposedly rabid animals is intense. The cost of the Pasteur treatment is also to be considered and materially enhances the economic importance of the disease.

During the past year the 33 positive cases received in this one laboratory from the District of Columbia and vicinity were animals which had inflicted bites on 16 people, 46 dogs, 2 horses, and 2 cows. Eleven cases were also received from more distant parts of the country, and these animals bit 20 people, 1 horse, and many sheep. In connection with these cases 36 people have, therefore, been subjected to the worry, anxiety, and actual danger resulting from the bite of a rabid animal, and have been required to take the Pasteur treatment. This does not include the financial loss connected with the necessary destruction of valuable dogs and other domestic animals which have been either infected or exposed to infection. Other laboratories in various parts of the country could probably show equally if not more impressive statistics in regard to the importance which rabies is assuming at the present time.

POPULAR FALLACIES CONCERNING THE DISEASE.

In the category of infectious diseases rabies stands at the head of those about which the ideas of the general public are most at variance with the actual facts. It is commonly believed that a person bitten by a dog in perfect health is liable to become affected with hydro-

phobia should the dog develop rabies at any subsequent period, however long afterwards. Consequently believers in this theory are particularly anxious to have the dog killed at once before he has had an opportunity to go mad. Nothing could be more fallacious and at variance with our knowledge of all infectious diseases, and the killing of the dog should always be discouraged.

Until recently it was considered that the dog's saliva became virulent only three days before the appearance of symptoms of rabies. According to some recent experiments by Nicolas it has been found that the saliva may become virulent six or even eight days before the symptoms develop. Therefore in case the animal remains healthy for ten days after it has bitten the person or animal, no danger need be apprehended from that bite even though the dog develop rabies within the next few weeks.

MADSTONE.

The curative value of the madstone is still devoutly believed in by a great many people in certain sections of the country. Within the last few years a madstone was forwarded to the Department, the owner stating that it had prevented several cases of rabies and he was anxious for it to be tried by the Bureau. Some of these madstones, properly called hair balls, are obtained from the stomachs of various wild and domestic animals. They are in some cases composed of matted hair which the animal has licked from its body and swallowed; but in the majority of cases they consist of masses of vegetable fiber, such as the awns of clover and beards of grain, which have gradually collected over a considerable period of time and are formed into a spherical shape by the contraction of the gastric walls. Gallstones, intestinal calculi, and in fact any porous stones may be used as madstones.

After a person has been bitten the madstone is applied to the wound, and it is believed that the longer it adheres the more sure it is of preventing the disease. Whether it will stick or not depends entirely on the amount of hemorrhage or discharge from the wound. Where this is profuse the blood infiltrates the meshes of the madstone, soon coagulates or dries, and tends to hold it in place, and it adheres for a considerable time under such circumstances. In these cases the virus is supposed to be removed and the treatment is heralded a success. On the other hand, where the wound is small and the discharge slight there is nothing to hold the stone in place and it immediately falls off. Certain of these madstones have been held in families for three or four generations and are guarded as carefully as any heirloom. Cases have been known where people have made long journeys and paid large sums of money to have a madstone applied. Its specific value against rabies is no greater than that of a piece of blot-

ting paper applied in the same manner. The application of mad-stones gives the unenlightened public a false sense of security, and their use should be discouraged by all possible means.

RABID DOGS AND WATER.

It is commonly believed that mad dogs will not go near water, and in case such an animal is seen to ford a creek or lake it is taken as proof that he did not have rabies. This fear of water is a symptom usually marked in human cases, but is never present in the dog at any stage of the disease. Animals in the early stages when running about the country will cross bodies of water without the slightest fear. Even after the throat becomes completely paralyzed the animal will often constantly attempt to drink water from a pail or bucket if placed within its reach, but, owing to the paralysis of the throat muscles, swallowing is impossible.

DOG DAYS.

The idea is prevalent with many people that dogs are particularly liable to go mad during the so-called "dog days," which extend from the first of July to the middle of August. These days are called "dog days" because they cover the period of time when the dog star Sirius is above the horizon with the sun; they have no connection with the dog. On account of the clemency of the weather dogs probably travel about during this season more than in winter, and hence are slightly more liable to infection. Statistics, however, as well as our own experience about this section of the country, show that the disease is present throughout the year, and seasons have very little if any influence.

COLOR OF THE ANIMAL'S MOUTH.

It frequently occurs after a person is bitten by a dog that some friend will immediately look into the mouth of the animal. In case the mucous membrane is black, he will at once conclude that the bite is dangerous, even though the dog appears perfectly normal; but, if the mouth happens to be red, he thinks there is no danger from the bite. This is entirely erroneous. The black color is due to a normal deposit of pigment in the mucous membrane of the mouth. It is present in a certain percentage of all dogs and has no connection with rabies. In this paragraph the writer is not referring to the so-called "black tongue" of dogs in the South, which is the vernacular name for dumb rabies, resulting from the swollen, darkened appearance of the tongue following its extrusion from paralysis of the lower jaw. This will be referred to in the section on symptoms (page 14).

LYSSOPHOBIA.

Many educated men, including some physicians, claim that all cases of hydrophobia in the human family are the result of wrought-up nervous excitement due to fear on the part of the patient. While at times these symptoms, termed lyssophobia, do occur in neurotic individuals who have been bitten by healthy dogs, they are always hysterical in nature, cause no organic lesions, and universally terminate in recovery. Thus lyssophobia is entirely distinct from the real disease, which is universally fatal to the human being.

SPONTANEOUS RABIES.

In many instances the origin of an outbreak of rabies is difficult to trace. This has given rise to the opinion that the disease may appear in the dog spontaneously, that it is an intrinsic part of his being which may crop out at any time under various extraneous conditions. This is as impossible as it would be for typhoid fever, tuberculosis, or any other infectious disease to develop spontaneously. Rabies is an infectious disease and can be produced only by inoculation with the specific virus which causes it. This specific virus is present in the saliva of animals affected with the disease and is transmitted to other animals and persons by the saliva on the teeth of such animals.

SKEPTICISM AS TO EXISTENCE OF RABIES.

In spite of all the work that has been done on rabies there are still many persons, including some medical men, who are skeptical regarding or absolutely disbelieve the existence of this disease. Some physicians say that they have been practicing fifteen, twenty, or thirty years and have never seen a case; but this proves nothing. During the past fifteen years but three cases of the disease have occurred in human beings in Washington, D. C. It can be readily seen, therefore, that only a small percentage of the medical practitioners would see them.

Others have advanced the statement that in Constantinople, where there are more dogs than in any other place of equal area in the world, rabies is unknown. This statement has been disproved by Remlinger, director of the Imperial Bacteriological Institute in that city, who reports many cases of the disease in Constantinople and adjoining provinces. But even if it were a fact, it is no more remarkable than the fact that in London, where there are more people than in any other place of equal area in the world, bubonic plague is unknown, which fact, however, is not remarkable at all. It simply means that the specific cause of the disease is not present in that particular locality.

Any person in the United States can see cases of rabies in one or more species of domestic animals if he will get in communication with

veterinarians, health officers, or laboratories where the disease is constantly being found. With the increasing frequency of the disease in the United States and the characteristic microscopic changes which can be constantly demonstrated, together with the fact that many prominent investigators have been writing on the subject lately, especially in reference to the Negri bodies, there appears to be less skepticism in regard to the disease.

PERIOD OF INCUBATION.

The period of incubation of rabies varies within wide limits, being more or less different in the various species of animals. It also differs in the same species, depending on several important factors, as the location of the bite, the character of the bite, and the amount of the virus injected. Bites about the head, face, and hands in human beings are the most serious because these parts are the most exposed. The clothing on other parts of the body tends to wipe the saliva from the teeth, and thus prevents it from inoculating the wound. Bites about the face and head are also more dangerous than on other parts because they are so thickly supplied with nerves and the distance the virus has to travel to reach the central nervous system is short. Through experimentation it has been pretty definitely proved that the virus travels along the course of the nerves rather than by means of the blood current. Deep, penetrating, or lacerating bites are obviously of greater import than superficial scratches, as more virus enters the former wounds and they are difficult or impossible to cauterize completely. Severe hemorrhage from the wound is favorable, as there is a possibility of part or all of the virus being thus mechanically removed. Infection and suppuration of the wound may also destroy the virus. None of these conditions, however, can be depended upon, but they account for the fact that a considerable proportion of persons and animals bitten do not contract the disease even when no treatment is given.

The shortest period of incubation is six days in the rabbit. This short period can only be obtained with what is known as "fixed virus" obtained in the laboratory by repeated passage of the ordinary virus through a long series of (50) rabbits. The disease as contracted from the bite of a rabid dog requires an incubation period of from fifteen to ninety days. At times this incubation has been prolonged greatly in excess of the above figures. In one case which came under the observation of this laboratory a dog belonging to one of the District fire companies was bitten by a rabid dog which was examined by the Bureau. The animal, being a great pet, was not killed and remained normal for exactly one year, when it came down with a typical case of rabies which was proved by microscopic examination and rabbit inoculations. Such a long incubation period,

however, is so extremely rare that it is usually not considered in formulating quarantine laws for the prevention of the disease. Shorter periods of incubation than fifteen days have been reported, but they are very unusual.

SYMPTOMS OF RABIES IN THE DOG.

The symptomatology of rabies is of primary importance, since a knowledge of the manifestations is the only ante-mortem method of recognizing the disease, thereby allowing measures to be taken to control the animal, and thus prevent its doing any serious damage. The symptoms are generally described under two types, the furious or irritable and the dumb or paralytic. The latter type is always seen in the terminal stages of the former; and, when the cases are of the dumb form from the outset, it is probable that the toxemia is overwhelming, and such cases usually run a more rapidly fatal course.

THE FURIOUS TYPE.

In the furious type, following the variable period of incubation, there is first noticed a change in the disposition of the animal, which should at once excite suspicion. Playful animals become morose, and quiet, reserved dogs may become unusually affectionate. The animal is nervous and easily excited, but obeys any command of its owner. In the course of a day or two the nervous condition increases and the animal becomes irritable and may snap if approached suddenly or startled. The bark becomes changed to a long drawn out combination of a whine and a howl, impossible to describe but never forgotten when once heard. Some dog owners speak of it as being somewhat of the nature of the bark of a foxhound while in the hunt, but this does not properly describe it. The animal if loose may pick up and swallow straw, sticks, stones, leather, and other foreign bodies. In some cases there is a tendency to bite parts of the skin, usually at the point where the animal was bitten, and in one case under the writer's observation the animal chewed the skin over the os calcis until the entire head of the bone was exposed to view. This tendency to bite the skin is probably due to an intense localized pruritis.

There is a marked tendency in these early stages for the animal to seek quiet spots and to hide in corners or dark places. If an attempt is made to remove the animal, the person is in great danger of being bitten. The restlessness of the animal becomes more marked. He may stand looking intently into space as if at an imaginary object. There is difficulty in swallowing, and saliva may dribble from the mouth. The irritability increases until the animal becomes furious, biting at a stick or other object thrust toward him. At this stage if the animal

is not secured he may leave home and travel for miles. During the long journey he will fight with dogs and attack other animals in his path, but never barks or makes any outcry during these attacks. The animal may go 20 or 25 miles from home, but always returns, if not prevented, in an exhausted condition, covered with wounds and dirt and greatly emaciated. Signs of commencing paralysis now appear, with dropping of the lower jaw, inability to swallow, and irregularity in the pupils. The legs finally become paralyzed and the animal passes into the dumb form of the disease.

DUMB RABIES.

This form of the disease occurs in only a small percentage of the cases. The symptoms are somewhat similar to those of furious rabies except that marked irritability is absent and there is an early appearance of paralysis. - This form of the disease, therefore, renders the dog less dangerous than the furious type. The animal lies quietly in some secluded place and appears to be stupid. The paralysis of the jaw comes on early, the tongue protrudes and becomes congested and covered with dirt, giving rise to the term "black tongue," which is a bad synonym used in some localities, especially in the South, for this form of the disease. The use of this term to designate dumb rabies should be discouraged, as it tends to confound the disease with dog distemper. The hind legs, trunk, and forelegs become paralyzed, and death usually ensues in about three days, while the furious type lasts from six to eight days.

Recovery from rabies in the dog after well-marked symptoms have developed is possible, and authentic cases have been reported by Pasteur, Roux, Babes, Courmont, and Remlinger. This is so rare, however, that it is of little importance except in cases where a person has been bitten by a dog showing all the symptoms of rabies and the animal afterwards recovered. The saliva in such cases remains virulent for several days or a week after the subsidence of symptoms, and a diagnosis can be made by inoculating rabbits with some of the salivary secretion.

SUMMARY OF SYMPTOMS.

The important symptoms, any one of which when well marked should render the dog suspicious and lead to its being confined, are: (1) Change in disposition; (2) alteration of voice; (3) inability to swallow; (4) leaving home and returning in an exhausted and emaciated condition; (5) paralysis of the jaw; (6) swallowing abnormal substances, as wood, stones, etc.

PROPER DISPOSAL OF DOGS AFTER BITING PERSONS.

In many cases in which a person is bitten by a dog there is immediately a great popular clamor to have the animal at once destroyed. This should always be discouraged. The mere fact that a dog inflicts a bite on a human being does not by any means prove that he has rabies. This is the dog's only means of defense and he bites instinctively when harmed. When the dog has been killed at once and sent to the laboratory, an examination is made for the microscopic evidence of rabies, which often is not found, as in many such cases the dog is not affected with rabies. In order to be on the absolutely safe side, however, the laboratory is then required to inoculate rabbits with the brain tissue. The incubation in rabbits requires at least two weeks, during all of which time the person bitten is kept in suspense. On the other hand, if the animal were left to live it could be examined by a competent veterinarian for evidences of rabies, and if it remained normal for ten days the bite would be harmless.

Therefore, after a person has been bitten, do not kill the dog unless a competent veterinarian has pronounced the disease rabies or the dog is showing well-marked symptoms. Instead, when practicable, the animal should be tied up securely and watched carefully for a week or ten days. In case suspicious symptoms do develop the dog should be examined by a veterinarian familiar with the disease, and if he pronounces the case rabies the animal may then be killed and the laboratory will be able to find the pathognomonic microscopic evidences. At the end of ten days the dog may be killed, if so desired, but if the animal is valuable and shows no symptoms of rabies there is no reason for destroying it. In this way valuable dogs can often be saved to their owners.

POST-MORTEM EXAMINATION OF CARCASS.

When a dog suspected of having rabies has died or been killed a post-mortem examination should be made. In rabies there are no absolutely characteristic post-mortem findings. Particular attention should be paid to the stomach. The mucous membrane of this organ is frequently congested, and in some cases a marked hemorrhagic inflammation is present. Foreign bodies, as sticks, straw, stones, coal, dirt, etc., and an absence of food in the stomach are very suspicious indications of rabies. The absence of these conditions, however, does not by any means exclude rabies. Undoubted cases of the disease have frequently been received at this laboratory where a considerable quantity of food was present in the stomach and the mucous membrane was in a normal condition. Redness and congestion of the pharynx and larynx with cerebral and meningeal congestion are also

to be found in some cases. A negative post-mortem examination when the animal has died naturally also tends to suggest rabies as the cause of death. From the fact that the pathological alterations are not constant they are not relied upon to any extent in this laboratory. There are cases, however, in which, the microscopic changes being indefinite, we are forced to get all possible information, including history and post-mortem findings, if we are to draw conclusions without waiting for rabbit inoculations to decide definitely the diagnosis.

METHOD OF PREPARING PARTS TO BE FORWARDED TO LABORATORY.

It is only necessary to forward the head to the laboratory after the post-mortem examination has been made. This is removed with the skin intact by cutting through the middle of the cervical vertebræ. It should then be wrapped in dry cheese cloth or other material and forwarded by express. During very warm weather the head, after being wrapped, should be placed in a tin receptacle and packed in a wooden box containing chopped ice. By removing the head at the middle of the cervical vertebræ the plexiform ganglia are left intact, and upon arrival at the laboratory they can be removed and examined microscopically for the lesions described by Van Gehuchten and Nelis, and a diagnosis can be made within twenty-four hours.

This plan is not practicable in summer when several days are required for the head to reach the laboratory, as the brain undergoes softening, becomes invaded with bacteria, and the experimental rabbits inoculated are liable to death from septicemia. Putrefactive changes are also liable to occur in the ganglia, and thus render the conclusions from their examination indefinite. In case the time required to reach the laboratory is considerable and the weather warm, the brain, including the medulla oblongata, should be removed as carefully as possible in one piece, immersed in two to three times its volume of pure neutral glycerin, and sent in this manner. In large animals one cerebral hemisphere and the medulla are sufficient. In some cases even with this method the Negri bodies can be demonstrated in the large nerve cells of the hippocampus major, and thus a diagnosis can be made in a few hours without waiting for the rabbits to develop the disease, which requires from two to three weeks.

It must be remembered, however, that to get the best results with the rapid methods of diagnosis it is essential that the animal be allowed to die naturally from the disease or that it be destroyed only after symptoms are well advanced. When the animal is killed in the early stages the changes in the nervous system have frequently not developed sufficiently to be recognized.

DIAGNOSIS OF THE DISEASE BY LABORATORY METHODS.

Until within comparatively recent years the only method of diagnosis of the disease after death was by inoculation of rabbits with an emulsion of the brain of the suspected rabid animal. This required an incubation period of at least fourteen days, and it was not an uncommon occurrence for the rabbits and the person bitten to develop simultaneously symptoms of the disease.

The examination of the nervous system for microscopic changes was begun as early as 1875. No diagnostic changes were known until 1886 and later in 1892, when Babes carefully described the histological lesions which he constantly found in rabies. The most important change which he found consisted in a degeneration of the nerve cells in the medulla and an invasion by embryonal cells of the space normally occupied by the nerve cells. These collections of cells were called by Babes rabic tubercles, and have since been named after their discoverer Babes tubercles. They are easily found in the majority of cases by making cross sections of the medulla and examining about the region of the central canal.

In 1900 Van Gehuchten and Nelis published the results of their work on the microscopic changes in this disease, which gave to the world a valuable addition to the methods of rapid diagnosis. The changes consisted mainly in a proliferation of the endothelial cells lining the capsule of the ganglionic cells and an infiltration of the ganglia with leucocytes. These changes are easily found and are most marked in the plexiform ganglia.

In 1903 Negri, of the University of Pavia, Italy, published the results of his researches and claimed to have found the causative agent of the disease, which consisted of cell inclusions, now universally known as Negri bodies, in the large nerve cells. (See fig. 1.) The relation which these bodies bear to rabies has since been confirmed by many investigators, and they are at present considered pathognomonic of the disease. Whether or not they are the real etiological factor in the production of rabies still remains to be proved.

Within the past year Porcher has laid great stress on the presence of sugar in the urine in cases of rabies. He says it is equally as valuable from a diagnostic standpoint as the Negri bodies or the changes of Van Gehuchten and Nelis, but his work requires confirmation. We have recently subjected the urine of two positive cases to Fehling's test for sugar, with negative result in both cases.

METHOD IN LABORATORY OF BUREAU OF ANIMAL INDUSTRY.

In the pathological laboratory of this Bureau when a suspected rabid dog is received a post-mortem examination is made. The

plexiform ganglia are removed and placed in 95 per cent alcohol. The skull is then opened and the hippocampus major and a small piece of the medulla are removed. The latter is placed in neutral glycerin and laid aside until the microscopic examination is com-

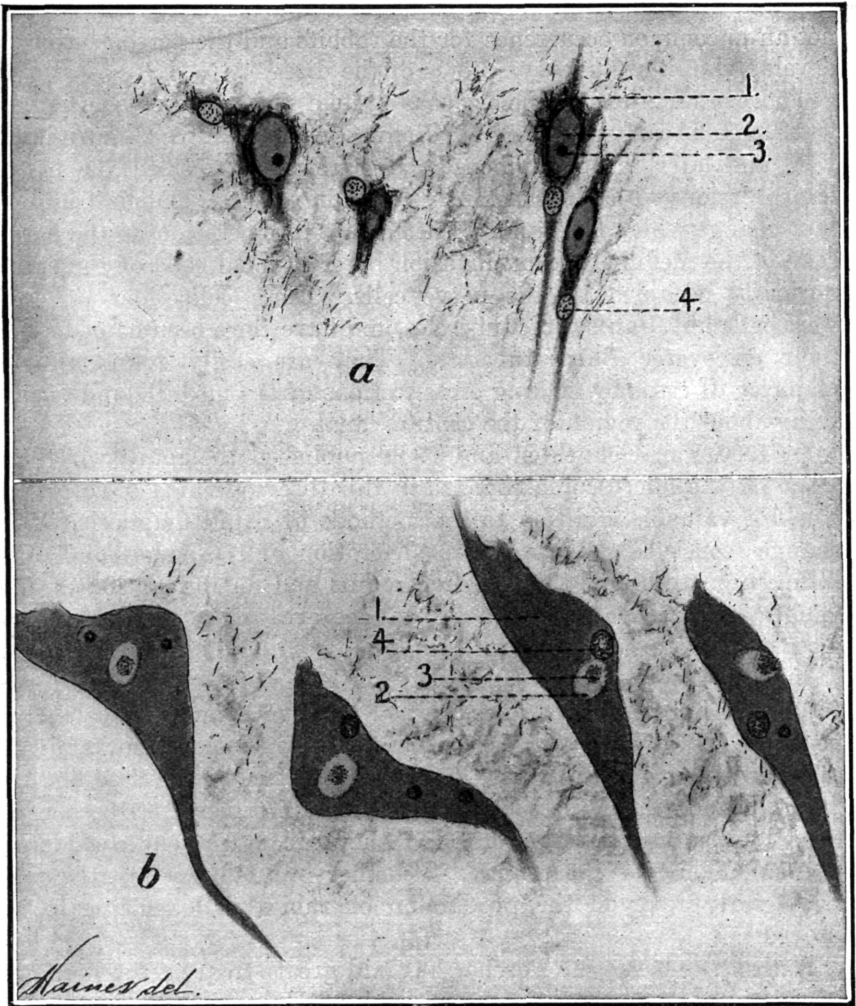


FIG. 1. *a, b.*—Nerve cells of the brain, showing Negri bodies, a diagnostic factor in rabies. 1, cytoplasm of cell; 2, nucleus of cell; 3, nucleolus of cell; 4, Negri body in cytoplasm of cell.

pleted: The Negri bodies being most numerous in the hippocampus major, this is placed in acetone and then in paraffin, by which method sections can be cut in three hours. The sections are stained with Mann's stain and examined. The Negri bodies, if present, are found in the protoplasm of the large pyramidal cells and stain a

bright pink color, while the cell takes a purplish tint. Frothingham's stain is also valuable. It consists in applying a saturated alcoholic eosin solution for fifteen minutes, followed by Loeffler's methylene blue, and decolorizing in 70 per cent alcohol, using the microscope to determine when decolorization is sufficient. With this method the nerve cell stains blue, while the Negri bodies appear yellowish pink and their granules stand out prominently, being stained very dark blue. Such an examination can be made in three or four hours, and when Negri bodies are found the diagnosis of rabies is made at once.

The touch preparation method of Frothingham is much more rapid than the preceding, but is not quite as reliable. It consists in making cross sections of the hippocampus and touching them to the slide. The thin film of nerve tissue adhering to the slide is then fixed in Zenker's fluid and stained with the eosin and methylene blue solutions.

When the Negri bodies can not be found the ganglia are examined. They are usually left in 95 per cent alcohol over night, transferred to absolute alcohol in the morning for an hour, and then placed in warm cedar oil in the paraffin oven for another hour. This clears the nerve fibers rapidly, leaving the opaque ganglia clearly outlined. One of the ganglia is then trimmed down with a sharp knife so that nothing but the ganglion remains, as in this condition the sections cut much easier. After trimming it is left one-half hour longer in the oil and then transferred to paraffin for one to two hours. It is then embedded, sectioned, and stained with hematoxylin and eosin. When Negri bodies are found the changes are always present in the ganglia. Where no Negri bodies are found and the changes are present in the ganglia, which rarely happens, the case is considered suspicious and rabbits are inoculated. These ganglionic changes may not be marked when the animal is killed early, and they may also be present in other diseases. In one case the ganglion of a horse which had died of cerebro-spinal meningitis at the Arlington Experimental Farm was examined and lesions similar to those of rabies were found. These changes may also rarely be present in dogs with distemper, especially when showing nervous manifestations. When Negri bodies are found, rabbits are not inoculated.

THE PASTEUR TREATMENT AND ITS RESULTS.

The preventive treatment of rabies devised and perfected by Pasteur has done much to strip this dread disease of its mortality among human beings. It was first advocated by Pasteur in 1885 after thorough experimentation on the lower animals.

In 1886 the original Pasteur Institute was opened in Paris. From that time until 1905, inclusive, 29,201 persons had been treated at this institute, with a mortality ranging from 0.94 per cent the first year to 0.18 per cent in 1902. During the four years from 1902 to 1905, inclusive, it averaged 0.32 per cent. The first Pasteur Institute in the United States was opened in New York City in 1890, and was followed by a similar institution in Chicago in July of the same year. During the first eleven years of its establishment the New York Pasteur Institute treated 1,608 persons, with a mortality of 0.68 per cent. The Chicago institute has recently issued a summary of its results from the time of its foundation to October, 1907. During this time 3,010 persons received the treatment and only 7 subsequent deaths from the disease resulted, making the very low mortality of 0.23 per cent. Eleven persons, however, died of the disease at the institute while under treatment. Ten dogs have also been treated and all of them were successfully immunized.

Recently N. G. Keirle, director of the Baltimore Pasteur Institute, connected with the College of Physicians and Surgeons, has published a report of the first 1,000 cases treated. Two deaths occurred, one of which was doubtful, as the man had chronic Bright's disease, although if this is included the percentage of failures is only 0.2 per cent. Eight other deaths occurred under his observation in persons who were either not treated or in whom the disease developed during or shortly after treatment.

Through the courtesy of Dr. A. G. Hoen, director of the Pasteur department of the University College of Medicine at Richmond, Va., we have received a report of the first 208 cases treated there without a single failure. Two persons who had received bites about the face died, one during and the second immediately after treatment, and are correctly not considered as failures by the institute. One dog was also successfully treated.

J. N. Brawner, in charge of the Pasteur Institute at Atlanta, Ga., has kindly reported that up to the present time they have treated 670 patients with only two deaths, one of these occurring in a victim of the morphine habit, the percentage of failures being only 0.33. Three other cases developed the disease during treatment. Doctor Brawner during the past seven years has also kept a careful record of all reported cases of persons bitten by rabid animals in Georgia who did not take the treatment, and of 120 such persons 29 died of the disease. This observation is of great importance and represents the signal value of the preventive inoculations which in this one instance showed a decrease in the mortality from 24 per cent without treatment to 0.33 per cent with treatment. The bites of rabid animals in Georgia, therefore, have proved 72 times as fatal without treat-

ment as with it. This institute has also treated 12 dogs and 5 horses, with no deaths.

The frequency of the disease throughout the country and the number of people consequently applying for treatment has led to the foundation of a number of Pasteur institutes. Besides those already mentioned there are others at Pittsburg, Ann Arbor, St. Paul, New Orleans, St. Louis, and Houston.

METHOD OF THE PASTEUR TREATMENT.

The principle on which the treatment is based consists in the production of an active immunity by means of repeated injections with an emulsion of spinal cords of rabbits dead from inoculation with fixed virus, which cords have been attenuated to various degrees by drying.

Rabbits inoculated with fixed virus die in from six to seven days. Their spinal cords are removed aseptically and dried in bell jars over sodium hydrate. Fifteen days of such drying renders the cord harmless, and such a cord is emulsified with normal salt solution and 2 or 3 c.c. of the emulsion is injected beneath the skin, constituting the first inoculation. Cords dried fourteen, thirteen, twelve, eleven, ten days, etc., are used for the subsequent injections, until finally an emulsion of a cord dried only three days, which contains practically all its virulence, is injected. The injections are made daily for a period covering fifteen to twenty-one days. The cost of the treatment is from \$100 to \$150 including board and room at the institute. The New York board of health has on several occasions prepared the material and sent the requisite dose each day by mail to physicians and veterinarians in other cities at the rate of \$25 for each course of treatment.

The treatment is not harmful except for the slight pain caused by the hypodermic injections. Patients are not required to remain in the institute constantly during the treatment, it only being necessary for them to present themselves each morning to have the injections made.

VALUE OF THE TREATMENT.

The value of the Pasteur treatment can not be overestimated. In 1896, nine years after the parent institution in Paris was founded, there were still many who doubted its value. In this year a commission was appointed by the House of Commons of England, consisting of Paget, Brunton, Fleming, Lister, Quain, Roscoe, Sander-son, and Horsley, to ascertain the value of the treatment. After exhaustive investigation this commission reported that Pasteur's inoculations were as valuable against rabies as Jenner's vaccination was against smallpox. The statistics of the large number of Pasteur

institutes during the past ten years are alone sufficient to prove that this was one of the greatest of Pasteur's discoveries. Without the treatment the mortality ranges from 10 to 80 per cent of the persons bitten. With the treatment the mortality statistics covering thousands of cases is always less than 1 per cent, and during recent years has been reduced to from 0.3 to 0.5 per cent. The observations of Brawner, of Georgia, noted above, are very convincing in this connection.

Although in the past the treatment has been principally confined to human beings, its equal value in the domestic animals has long been established. Its cost is too great for it to be used as a routine procedure on all animals exposed to the infection. There are, however, many valuable horses, cattle, and dogs succumbing annually to the disease, practically all of which could be saved by the preventive treatment. The Bureau of Animal Industry is consequently contemplating the routine preparation of this virus to be shipped by mail at nominal cost to veterinarians having exposed valuable animals under their care.

THE HÖGYES METHOD OF PREVENTION.

In Hungary the Högyes method of preventive inoculation is used exclusively. It consists in diluting the spinal cord of rabbits dead from fixed-virus inoculation with physiological salt solution. The dilutions made are 1:10,000, 1:8,000, 1:5,000, 1:2,000, 1:1,000, 1:500, 1:200, 1:100. The cord diluted 10,000 times with the salt solution is harmless and constitutes the first injection, 2 or 3 c. c. being injected. Then the stronger solutions are gradually injected until 1:100 is reached. With the stronger solutions only 1 to 2 c. c. are injected. Högyes claims that this method is far superior to that of Pasteur, and his statistics seem to prove his claim.

Since 1890 the Budapest Pasteur Institute, of which Professor Högyes is director, has treated 22,558 persons with 108 deaths, or a mortality of 0.47 per cent. Of this number, 3,410 were treated with Pasteur's method, of which 54 died, a mortality of 1.58 per cent. The remaining 19,148 were treated with the dilution method, of which number 54 died, or a mortality of only 0.28 per cent. While other institutes using the Pasteur method have had a much lower mortality than 1.58 per cent, the Budapest statistics amply prove the value of the dilution method. It is not being used, however, in any of the institutes in this country at the present time.

THE SERUM THERAPY TREATMENT AGAINST RABIES.

A great deal of work along the line of serum therapy has been done by Babes, Tizzoni, Centanni, and others, and some brilliant results have been obtained. The latter two investigators after ex-

haustive experimentation produced absolute protection against the disease in experimental animals by what they termed the Italian method of vaccination against rabies. It consists in the immunization of sheep by inoculations with rabic virus which has been attenuated by means of being digested with gastric juice. In order to keep the serum potent the sheep has to be revaccinated at intervals of from 2 to 5 months. The serum from such an animal when used in doses of 20 c. c. in the liquid or 2 to 5 grams in the dried condition is claimed to contain absolutely protective qualities against rabies in the human subject. It is even claimed to have curative effects after symptoms of the disease develop. Tizzoni and Centanni claimed that its greater efficiency and convenience would cause it to be completely substituted for the Pasteur vaccination. This claim, however, has never been realized, and its value on the human subject has not been satisfactorily demonstrated. The excessively elaborate technique required in its preparation will probably prevent its ever coming into general use.

ERADICATION OF THE DISEASE IN THE UNITED STATES.

If eradication were once accomplished all that has been said about treatment would be rendered unnecessary. Furthermore, rabies is one of the most easily eradicated of all infectious diseases.

The factor of success in the undertaking can be summed up in three words, namely, muzzling all dogs. Could this be efficiently carried out in the United States for a few years rabies would be entirely eradicated, as has been demonstrated by the experience of other countries. Other domestic animals have the disease, it is true, but its transmission by these animals is rare and need not be considered. Wild animals as a factor in its spread may require consideration in a few localized sections of the country.

When the muzzling of dogs is suggested, however, the sanitarian meets with many obstacles. Many dog lovers can not appreciate, or are indifferent to, the anxiety, mental terror, and suffering of several thousand human beings in our country yearly, and the actual death of from 100 to 300 yearly, not to mention the suffering and death of countless dumb brutes. But once a dog-muzzling law is passed dog owners are up in arms, using their time, influence, and money to secure its repeal or prevent its enforcement on the ground of alleged cruelty. In reality there is no cruelty whatever inflicted on a dog by causing it to wear a muzzle when in public places or running at large. The animals soon become used to it and manifest not the slightest inconvenience.

In the absence of muzzling the disease will continue year by year, causing constantly increasing suffering, financial loss, and death.

The greater freedom of movement which the dog enjoys over all other domestic animals, except possibly the cat, makes it difficult or impracticable to control the disease by any other means than general muzzling. How is this to be accomplished? This question seems to be almost insurmountable. A national dog-muzzling law is sometimes proposed as a solution, but the power of the Federal Government in dog muzzling, as in other matters, would be confined to those cases where the interstate dissemination of the disease is involved. The Secretary of Agriculture under present law could quarantine States where the disease exists, but it can readily be seen that it would be impracticable to enforce such a quarantine further than to require that all dogs transported interstate by common carriers should be muzzled. This, however, would have no material influence in the eradication of the disease. Practically all the States are infected, and the great majority of the serious outbreaks of rabies are entirely within the confines of particular States.

It is necessary, therefore, for the States and municipalities to take action and for the public to be educated to the importance of the disease and the value of dog muzzling. Dog-pound service should be increased in all the large cities. This results in the destruction of a large percentage of homeless and ownerless dogs, which class of animals are mainly responsible for keeping the infection of rabies alive. The importance of this service is shown by the effect which it had in Washington in 1900, when 2,771 more dogs were impounded than during the previous year, with an immediate and marked decrease in the frequency of the disease during the following year.

To secure individual State legislation in regard to dog muzzling, Federal cooperation, and the equally important education of the public will require concerted and unceasing action on the part of professional men and sanitarians, with the cooperation of the general public and the press. With such State legislation, the Bureau of Animal Industry could cooperate with the State authorities by placing officers within the confines of a State in case of an outbreak where the disease was spreading beyond the control of the State authorities. A large percentage of homeless and ownerless dogs could be impounded and humanely destroyed. No dog would be seen on the streets of cities or loose in the country without a muzzle. Animals developing the disease would be unable to transmit it, because they would be either muzzled or confined. Financial loss, suffering, and death due to this disease would rapidly decrease from the beginning, and in a few years' time rabies would be unknown in this country.

Once our country becomes free from the disease, we could easily prevent its reappearance by enforcing a prolonged quarantine of all dogs coming into the United States from foreign countries where the disease prevails.

RESULTS OF MUZZLING DOGS IN OTHER COUNTRIES.

To prove the practical value of these repressive measures we have only to observe the results obtained in foreign countries. Prior to 1875 rabies had been prevalent in Berlin for many years. In that year a law was enacted, including the whole of Prussia, which provided for the killing of dogs suspected of having rabies, and the muzzling and leading of all dogs when in public places. This led to the complete eradication of the disease, and no case has occurred in Berlin since 1883.

In Holland in 1875, rabies being quite prevalent, dog muzzling was established. The disease immediately began to disappear, and in 1879 only 3 cases were reported, since which time the country has been free from the disease, except along the Belgian border.

In Great Britain the value of muzzling, which was enforced in spite of great public opposition, has been admirably demonstrated. In 1889 it was first adopted, and the disease had almost disappeared by 1892, when the muzzling was stopped on account of the determined opposition. The disease immediately began to increase, and in 1895 muzzling was again enforced. The decrease in rabies was immediate and marked, and since November, 1899, the country has been entirely free from the disease.

In Sweden the value of muzzling has also been demonstrated. In fact, in all cases where this measure has been effectually carried out the disease has been completely controlled.

The disease has never been known in Australia. This is due to the fact that the infectious agent never gained a foothold in that country, and for a number of years the government has wisely prevented such an unfortunate occurrence by laws which absolutely exclude the importation of dogs into that country.

In countries where steps have been taken to exterminate rabid dogs—Holland, Sweden, Norway, and Germany—rabies in man has almost disappeared. In England, where the disease in dogs has been eradicated, and in Australia, where the affection has not been allowed to enter, the disease among the residents is unknown.

BIBLIOGRAPHY.

BABES, VICTOR.

Sur certains caractères des lésions histologiques de la rage. *Ann. de l'inst. Pasteur*, t. 6, no. 4, p. 209-223. Paris, April, 1892.

FROTHINGHAM, LANGDON.

Rapid diagnosis of rabies. *Jrn. of med. res.*, (whole no. 93) v. 14 (n. s. v. 9), no. 3, p. 471-479. Boston, April, 1906.

VAN GEHUCHTEN, A. and NÉLIS, C.

Diagnostic histologique de la rage. *Ann. de méd. vét.*, ann. 49, no. 5, p. 243-252. Bruxelles, May, 1900.

HÖGYES, ENDRE.

A budapesti Pasteur-intézetnek. 1903, évi kimutatása. *Orvosi hetilap*, évf. 48, sz. 49, p. 712-714, Dec. 4; sz. 50, p. 730-731, Dec. 11; sz. 51, p. 747-749, Dec. 18. Budapest, 1904.

HOEN, A. G.

The cell inclusions of Dr. Negri. *Bull. Univ. college of med.*, Richmond, Va., ser. 2, no. 20. Richmond, July, 1907.

KEIRLE, NATHANIEL G.

The fallacy and inutility of the so-called rapid diagnosis of rabies. *New York med. jrn.*, v. 85, no. 8 (whole no. 1473), p. 354-356. New York, Feb. 23, 1907.

LAW, JAMES.

Textbook of veterinary medicine. v. 4. Ithaca, publ. by the author, 1902. See chapter on Rabies and hydrophobia, p. 259-290.

NEGRI, ADELCHI.

Beitrag zum studium der ætiologie der tollwuth. *Ztschr. f. hyg. u. infektionsk.*, bd. 43, hft. 3, p. 507-528. Leipzig, June 30, 1903.

NICHOLAS, JOSEPH.

Apparition de la virulence dans la salive mixte des animaux rabiques. *Jrn. de méd. vét.*, t. 57, p. 208-218. Lyon, April 30, 1906.

REMLINGER, PAUL.

La rareté de la rage a Constantinople. *Rev. d'hyg.*, t. 25, no. 4, p. 309-313. Paris, April 20, 1903.

RAVENEL, MAZŮCK PORCHER, and MCCARTHY, D. J.

The rapid diagnosis of rabies. *Univ. med. mag.*, v. 13, p. 766-775. Phila., January, 1901.

RAVENEL, MAZŮCK PORCHER.

Rabies. *Dept. of agr. of Penna. Bull.* 79, 1901.

SYLVESTER, C. P.

Hydrophobia and its prevention. *Boston med. and surg. jrn.*, v. 157, no. 4, p. 97-101. Boston, July 25, 1907.

WILLIAMS, ANNA WESSELS.

Negri bodies, with special reference to diagnosis. *Proc. New path. soc.*, n. s., v. 5, nos. 4-8, p. 155-162. New York, May, 1905-Jan., 1906.

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